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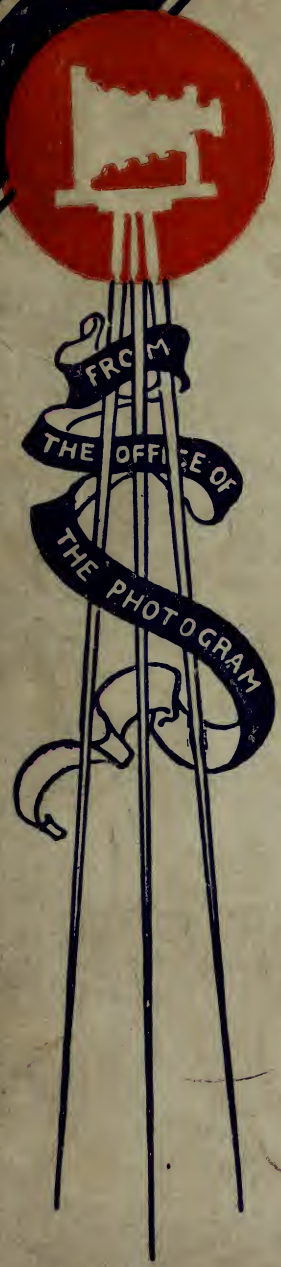

Toning Bromides

And Lantern Slides

C. Winthrope Somerville

F.R.P.S.

LONDON
DAWBARN & WARD, LTD.

TONING BROMIDES
AND LANTERN SLIDES

BY

C. WINTHROPE SOMERVILLE, F.R.P.S.

PUBLISHED FOR THE PHOTOGRAM, LTD.

BY

DAWBARN & WARD, LTD.

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[*Continued on page 6.*

AUTHOR'S NOTE

Experience is often hard gained; but if others benefit, there can be no regret.

LONDON, S.E., 1904.

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TONING BROMIDES

CHAPTER I.

CHIEFLY WARNINGS.

The choice of a printing process for artistic expression, were it sufficiently considered (and it very rarely is amongst amateurs), is dependent on something more than a complete mastery of the printed instructions provided by the manufacturer of the printing paper. A knowledge of the chemistry of the manufacture of the paper is quite unnecessary, and in the majority of cases would be useless information; *but* a knowledge of the possibilities of a process in all its branches is *everything*, since knowledge creates power, and a complete mastery eliminates failures. To this end, I have in this little work endeavored to give the reader the benefit of a personal experience, extending over many years,

in experimental research and applied work in the process of the color-toning of bromide prints, information on which has hitherto, for some unknown reason, been scanty enough in the technical press, and too scattered to be of much value to the average and incidental worker. It has been my aim throughout to make the various processes and their manipulations as intelligible to the beginner as to the more advanced worker. By this I hope to be not only successful in enabling the worker to produce the best results, but also instrumental in creating a desire for further general and particular information in the science and art of photography; thereby tending to its advancement and progression, of which it stands in sore need in this country.

With regard to the bromide printing process itself, to me it is the ideal of the present day. Its possibilities are greater than any other, therefore its fascination is more enduring; and of all its manipulations toning is the most fascinating. The pure black-and-white print—be the shadows of the softest dove grey or the deepest of transparent or liquid black—may be converted at will into almost any color, and generally with such rapidity and ease as to be quite exciting

to the beginner. Still greater fascination is engendered by the fact that in many processes the color may be controlled, or sought for and obtained, during the toning operation; may be stopped and retained at that stage, or passed over for a different shade.

Comparing the process for a moment with those of carbon and platinotype for color work alone—with carbon you choose your pigment beforehand, which may or may not give the desired effect in the finished print; at any rate, it is practically uncontrollable.

With platinotype it is possible to get a poor apology for a sepia, but with a tremendous amount of uncertainty; it is also possible to get some ambiguous tints of green and blue by means of uranium, which may or may not last. It is interesting to note, also, that the sepia platinum image of a platinotype print may be obtained on bromide paper by replacing the silver with platinum, and by practically the same chemical process. The comparative costs of the processes we will not enter into, as, although they are far and away in favor of the bromide, there may be many of my readers to whom this would be of no material importance. With regard to permanency, when we get images

composed of such substances as platinum, silver, gold, silver sulphide, etc., we may rest content with the fact that the paper on which they are supported will go first.

The question of surface is very satisfactorily answered by the fact that nearly all manufacturers supply qualities from the roughest of gros grain to that of a glossy enamel.

Throughout the work I have painfully refrained from any description of the artistic and pictorial beauty of the many and various tints to be obtained, leaving them with assured anticipation to the worker's own observation.

For the successful manipulation of the various processes I must impress upon the reader the great importance of the personal element. *Everything is dependent on it.*

To a certain extent all processes are mechanical, but only as regards the personal arrangements and precautions for their proper working, of which the following are important, and should be carefully considered before commencing work :—

(1) Since all reactions or changes are chemical ones, the necessity for chemical cleanliness is absolute. Cleanness at every stage not only prevents any interference with the production of

the desired tone, by providing a clear field for the particular reaction, but also, in making that reaction definite and complete, renders the result more permanent, a condition very essential when another change or secondary reaction is necessary to produce the final tone.

(2) When a tone can be produced by a single reaction between the original silver and the chemical, or mixture of chemicals, employed, it is better to adopt this method in preference to one more complicated and involving two or more changes in the silver salt, since a certain amount of strain, set up in the emulsion with each change, tends to produce impermanence; also the effect, and the extent of it, on the emulsion must remain unknown, thus rendering uncertain the amount of washing required to completely eliminate any free salts. *Except where expressly otherwise stated, it is an essential condition of perfect results that "hypo" be completely removed from the print before toning.*

(3) It is conducive to the best results to allow prints to dry before toning, and, either before drying or before toning, to subject them to ten minutes' immersion in a 10 per cent. formalin bath.

(4) The ultimate intensity of a toned print

is better judged by viewing it in a dry state before toning.

(5) If a toning process cannot be stopped at any stage before its finality, and the partially treated print washed, and then be considered as permanent as the completed tone, the process should either be abandoned or worked to the limit.

(6) Complete substitution of another metal for the silver leads in nearly all cases to greater permanence than does partial substitution or the formation of an amalgam : never employ a mercury salt if you can avoid it, unless the final tone is produced by complete substitution.

(7) Equality in the temperature of solutions and washing water is very important.

(8) Platino-matt papers are less liable to blisters than the glossy kinds, although the transparency of the shadow depth is not quite so fine. After mounting, prints are much improved by vigorously rubbing them with a plug of cotton-wool soaked in alcohol—methylated spirits will act as the next best thing—and, when dry, polishing them with a silk handkerchief, using considerable pressure.

(9) In using a process for the first time, it is advisable to make a trial with a spare print of similar intensity to the one to be toned, treated

under the same conditions and *with precisely the same amount of care.*

(10) Except where intensification or reduction occurs, the scale of gradation will remain practically the same in the toned print, with the one difference of the shadows being raised from the black to the deepest tint of the final tone. There are one or two exceptions to this. In the majority of the processes I can personally vouch for the tones obtained, but some of the tints vary slightly with different makes of paper; also in some instances different processes give similar tones, so that I may not have worked them all, or may have chosen one in preference to others. In all cases where I have found a process unsatisfactory I distinctly state the fact, but I wish the reader to bear in mind that this may be due either to ignorance or bad manipulation on my part, although, in justice to many untiring efforts to make the best of a bad process, I have, with a very fair knowledge of the chemistry of the work, eliminated every possible error liable to involve poor results in such cases, and have often substituted different reactions tending to produce the same tint.

(11) In the case of large work, where economy is a consideration, the soaked print

may be laid in the dish—which is stood nearly on end—and the solution applied by means of a broad camel-hair brush drawn from side to side across the print, the solution collecting in the bottom of the dish being used over and over again. Prints should be soaked for *at least* five minutes before toning.

(12) Thorough washing, where stated, must be strictly adhered to.

(13) Tones vary slightly with some developers, but the difference is not very material; I have, however, obtained the most effective results with prints developed to the blue-black tone characteristic of metol-hydroquinone. This is undoubtedly one of the finest developers for bromide work, and for those who may care to adopt it I give the following formula, which is the result of numerous experiments to obtain the most effective combination :—

Metol	100 grains.
Hydroquinone . .	50 ,,
Sodium sulphite . .	3 ounces.
Potassium carbonate .	1½ ,,
Water	80 ,,

10 per cent. solution of bromide of potassium to be added as required.

The keeping quality of the above is practically indefinite, and it may therefore be made up in the volume given.

(14) In all cases I have given the time of washing for running water: where this is not possible, frequent changes extending over about double the time should be given.

In choosing a process there are three items to be considered: color, efficiency, permanence. Convenience I leave entirely to the individual worker.

In the case of sepia tones there are several methods for obtaining this brown-black or brown-black-red color, but as a matter of fact only one of them approaches near to the actual sepia water-color, and that is the platinum process discovered by myself some six years ago. This, however, with the exception of the hypo and alum process, takes longer than any of the others. It is possible to vary it slightly as stated.

The sulphiding processes are the most rapid, occupying but a few minutes, but the color is distinctly a brown-black, with perhaps a tinge of purple. The image is permanent, and the tone cannot be varied except by incomplete bleaching. Ferguson's copper process will not give a pure

sepia, or even a brown-black, as there is always too much of a purple tinge. The uranium process I most strongly condemn as uncertain, impermanent, and altogether unsatisfactory. It is only given in this work in order to make it as complete as possible.

Sepia tones obtained with Schlippe's salt (sodium sulphantimoniate) are not to be recommended in preference to others.

With regard to red tones, the copper method is undoubtedly the best.

A purple tone obtained by replacing the silver with gold is the most permanent.

Tones obtained with iron salts, such as green, blue, and blue-green, are more permanent if the print first be bleached with potassium ferricyanide; but processes for obtaining them direct in one operation *may* be equally permanent, but in no case more so. It is impossible to make a comparison in the way of beauty of results, as in doing so we must inevitably enter the region of the artistic, and I will not be held responsible for any crime in the way of opinion. In every case where a tone is a good one, I think I have definitely stated the fact.

I believe all toning processes for bromide prints work well with gaslight papers, although

the intensity of the tone in many cases is not so great; this I think is due to the fact that gaslight papers contain a greater proportion of chloride of silver in the emulsion. Personally, I am not in favor of this paper in preference to bromide, as the scale of gradation is much shorter and the possible variation of effect much less.

CHAPTER II.

PRELIMINARY TREATMENT.

As before stated, successful toning is to a great extent dependent on the state of the silver deposit in the developed and fixed print. A process which either increases or reduces the intensity of the image is in no case a satisfactory one, since an element of uncertainty is introduced. It can be satisfactory only when we know that the intensity secured in the black cannot be altered except at will. In most cases of toning it naturally follows that the deepest shade or tone-value in the black will be raised to the deepest shade of the color to which it is toned. Isolated cases in which this does not occur are two of my own processes, viz. those for green and blue-green; here the tint is imparted to the black instead of the black being raised to the prevailing color.

Now it must be clearly understood that

except where intensification or reduction occurs the scale of gradation will remain precisely the same after toning, and therefore the desired effect in tone-values should be definitely secured in the black. If a tone or shade is rich and transparent in its intensity in the scale from black to white, it will be so after toning. At the same time, it must not be forgotten that while toning does not alter the highest tone-value, *i.e.* white, it changes the rest of the scale to the values of the particular color; and as black is the lowest tone in nature, a toned print may appear generally lighter than was anticipated, if allowance is not made for this fact. "Muddiness"—I presume every worker in bromide will understand what I mean by this technical expression—or clogged shadows in a bromide print will be infallibly retained during toning, except where intensification occurs. This muddiness may be easily eliminated by treatment with the cupric bromide intensification process (p. 22). As this process plays such an important part in all bromide work, it is my intention to dwell at some length on its peculiarities and value.

Where a tone is obtained by the substitution of another metal for silver, it is of the highest

importance that the original deposit be pure silver. Thus, treatment with mercury, which will form an amalgam with the silver, or treatment with any other metal combining with silver, no matter for what purpose, is to be absolutely condemned. Hence, mercury in any shape or form *must not* be used for the intensification of bromides when toning is contemplated. As a matter of fact, mercury should never be used in connection with intensification, since by its amalgamation with the silver it tends to render the image impermanent.

For the purpose of intensification or the clearing of shadows the silver deposit should first be converted into bromide of silver and then re-developed. The process is rapid and simple, and may be carried out in daylight if intensification is desired, but for clearing purposes and substitution it should be manipulated by gaslight.

Cupric Bromide Solution.

Copper sulphate . .	200 grains.
Potassium bromide .	200 ,,
Water . . .	10 ounces.

This solution keeps indefinitely, and can be used again and again until it commences to act

too slowly. After the thorough washing of the fixed prints, I would strongly advise the practice of immersing them for a few minutes in 10 per cent. formalin, rinsing again in water, and then drying before any intensification or toning operations.

Intensification.

Soak prints in water till flaccid, and immerse in the above cupric bromide solution. They will bleach in about two to three minutes. They are then washed in a few changes, or in running water, to remove the copper solution; but, as it is not possible to get rid of all traces by washing, the print is subjected for three minutes to a 5 per cent. solution of nitric acid, and again washed for five minutes. The image now consists of silver bromide, and as such is in a condition for intensification, shadow-clearing, or "substitution."

For intensification the print should be exposed to daylight for a few minutes, when it will assume a bluish tint and print out to a considerable extent; it is now re-developed with a developer of normal strength as used for the print in the first instance, to 1 ounce of which three drops of 10 per cent. bromide of potas-

sium have been added. Development should be continued for three or four minutes after it appears to be complete. The print is now washed for ten minutes, dried, and toning proceeded with if desired. If the intensification has been insufficient, the whole process may be repeated. Where great intensity is required, a $2\frac{1}{2}$ per cent. solution of silver nitrate may be applied instead of the developer, but with some papers, especially those of thick texture, there is a liability to staining; in any case the washing between the various operations must be scrupulously complete.

Shadow clearing.—For this purpose the operations should be carried out by gaslight, otherwise they are precisely the same as for intensification. This is an invaluable process for rectifying flat and muddy prints obtained from correspondingly flat and fogged negatives. Prints should be exposed and developed to just within the veiling point of the highest lights, and then cleared or intensified as directed. It is a very fascinating instance of the superiority of the bromide over other processes, rendering us almost entirely independent of the quality of the negative.

Substitution.—For such toning as silver

sulphide, and gold, the color is obtained by the substitution of these substances for the original silver, and is effected from the bromide of silver image. The reagent for producing the tone is applied to the print after washing from the nitric acid.

The great advantage of the cupric bromide method of intensification is that the image is simply reduced by re-development to pure silver. If, on the other hand, mercury be used, followed by ammonia, a compound di-mercurous ammonium salt is formed ; and complex compounds of uranium and lead are also formed when these metals are used. It follows, then, that a probable and unknown reaction between these and the toning reagent employed will take place.

CHAPTER III.

STRENGTH OF SOLUTIONS.

It is both chemically advisable and convenient to keep all chemicals in solution, adhering where possible to a standard strength. Ten per cent. is a universal standard strength, one that is not too strong to produce decomposition in solution and not too dilute to necessitate too large a volume when combining with other chemicals to make a compound solution of certain volume.

All analytical chemists use the metric system of weights and measures, and it is to be regretted that the British Government is not sufficiently enterprising to pass a law for its universal adoption; but as it is, we are compelled to muddle round with three systems of weights, all of which occur in photography. When purchasing salts of gold, platinum, etc., you get 480 grains to the ounce; with hypo you get 437½ grains to the ounce; if you obtain anything from a

pharmaceutical chemist, you may or may not get your weight on the apothecaries' system. Personally, I invariably prepare my solutions in grammes per c.c., but as very few workers will have gramme weights, I shall deal throughout this work in grains per ounce.

There are 480 minims in 1 fluid ounce, therefore a 10 per cent. solution would contain 48 grains per ounce; but for small measures this is a little inconvenient, and it is much better to weigh out 50 grains to every ounce of water, and then add 20 minims. This gives 50 grains in 500 minims, and consequently 1 grain in 10 minims, which is equal to a 10 per cent. solution.

If the solubility of a chemical will not allow of this concentration—and a few will not—use a multiple of ten for the increase in volume.

Workers will find it convenient if they will label their bottles thus :—

POTASSIUM FERRICYANIDE.
10% SOLUTION.
1 grain = 10 minims.
Date.

Solutions *ought* to be made up with distilled water, or failing that, filtered boiled water, since

ordinary tap water contains many impurities, such as chlorides, carbonates, silicates, iron, alumina, etc., and organic substances which may cause unsuccessful toning. Salts of gold, platinum, silver, and vanadium *must* be dissolved in distilled water if their maximum efficiency is to be retained. Distilled water is given in all formulæ where it is absolutely necessary.

CHAPTER IV.

SEPIA TONES—THE PLATINUM PROCESS.

In a paper read before the Royal Photographic Society in 1902 I gave a method of obtaining sepia tones by means of a platinum salt, being the result of several years' research in an endeavor to replace the silver in a bromide print by platinum. In the matter of the replacement or substitution, the process is eminently successful, the deposit of platinum being of a pure sepia color, when there is sufficient silver to replace. But it is with regard to this and the toning of a bromide print that some uncertainty would be present if the ultimate tone were required to be from a deposit of pure platinum, since the original intensity of the print would have to be considerably greater than the normal. If, however, we can be content with a partial substitution—a combination of platinum and silver—then the tone, and the

ease and certainty with which it is obtained, is very fine.

In a later communication to one of the technical photographic journals I recommended the optional employment of perchloride of platinum for the toning solution, and now much regret having done so, as further experiments have shown that an excess of chlorine in any form, either in the solution or the emulsion, is prejudicial to the permanency of the print.

The following formula contains the minimum quantity of platinum which I have found to work efficiently in combination with the other salts, and, roughly speaking, is sufficient to tone 100 square inches area containing an average amount of silver deposit :—

Potassium chloroplatinite .	2 grains.
(equivalent to about 1 grain of platinum.)	
Mercuric chloride . . .	1 grain.
Citric acid	9 grains.
Water (distilled) . . .	1 ounce.

The best method of preparing the toning solution is to mix it from concentrated standard solutions of the salts.

The potassium chloroplatinite should be dissolved in sufficient *distilled* water (to which a

few drops of hydrochloric acid have been added) to make 30 minims equal to 1 grain of the salt. The bottle should be kept in the dark.

The mercuric chloride is dissolved in distilled water and made up to a convenient strength of 1 grain to the dram, and a few drops of hydrochloric acid added.

The citric acid must not be too concentrated, otherwise a fungus growth occurs if the solution is kept too long.

The speed of the toning is governed by two factors—the concentration of the solution, and the amount of silver deposit. Thus a print containing an abnormal amount of deep shadow will require correspondingly more platinum. This is an important point to remember, for on no account should the platinum be stinted. The quantity of platinum that may be used (with quantities of the other salts given) is unlimited, and if three drops of 10 per cent. solution of bromide of potassium be added to the above formula, staining from the platinum (which otherwise may occur) is prevented, but the tone will be of a slightly colder sepia, while the speed of toning is increased.

Increasing the quantity of mercury by $1\frac{1}{2}$ times tends to give a slightly weaker color.

Prints are previously soaked in water for fifteen minutes, and rocked occasionally during toning. The formula given will tone three or four half-plate prints in about twenty minutes. Enlargements may be economically toned by standing the dish at an angle of about 60° and applying the solution by means of a broad camel-hair brush; and if the dish be tilted slightly on one corner the solution will collect in sufficient quantity to allow the brush to be dipped in it. Commencing at the top of the print, the passage of the brush should be from side to side.

The presence of bromide of potassium creates initial intensification, but the effect is only temporary, and dies away as toning proceeds, the original scale of gradation being faithfully preserved with the final tone.

If the toned print be immediately subjected to an ordinary bromide paper developer the black color will return, with great intensification; but prolonged washing will prevent this.

A great feature in the process is the hardening action on the film, effectually preventing the formation of blisters.

After toning, the print is washed for ten minutes.

This process is one of the best for obtaining *sepia* tones.

Another Formula.

Another formula for producing a similar tone was brought out about a year later by Dr Francis Heatherley,[1] and is to be recommended, especially as the toning area per grain of platinum is greater than the above :—

Oxalate of potash . .	½ ounce.
Mercuric chloride . .	20 grains.
Citrate of potash . .	30 ,,
Citric acid . . .	1 dram.
Water (tap and hard) .	3½ ounces.

To the above add just before use :

Potassium chloroplatinite .	3½ grains.
Hydrochloric acid . .	3½ ,,
Water	3 ounces.

By passing the toned print through a solution of washing soda the brown is deepened, and if left in the solution, the result is a double intensification by platinum and mercury.

Later experiments with my own formula have shown that the mercury simply acts as the

[1] *The Photogram*, Nov. 1903.

reducing agent of the platinum, and the presence of the citric acid prevents any permanent combination between it and the silver, also, at the same time, preventing a combination with the gelatine. But the sepia tone is undoubtedly produced by a combination of the platinum and silver, for, if the print be immersed in cupric bromide, the silver will be converted into silver bromide, and on treatment with hypo dissolves away, leaving a pure platinum image behind of a lighter and browner shade. I have said that prolonged washing will prevent intensification by development, but it has failed in this respect with some papers. The chemistry of the process is rather complicated, but the manipulation is very simple, and the tone permanent up to at least six years.

CHAPTER V.

SEPIA TONES—THE SULPHIDE PROCESS.

The substitution of silver sulphide for the silver forms a very rapid, simple, and permanent toning process. The rationale of the process is simple enough. The silver is converted into a halogen salt (*e.g.* bromide), and converted, by means of an alkaline sulphide, into silver sulphide. The silver may be converted temporarily into either the bromide, iodide, or chloride, the final tone always being the same. If converted into iodide, the starchy matter of the paper is affected, assuming a blue tint, and this must be removed by a solution of sodium sulphite before toning.

If converted into bromide by the method given, the print must be treated with a dilute solution of nitric acid before toning, in order to keep the whites clear. If converted into chloride by the method given, the print is treated with hydrochloric acid before toning.

The Bromide Process.

Bleach the print in—

Copper sulphate . .	200 grains.
Potassium bromide . .	200 ,,
Water	10 ounces.

Wash in running water for five minutes. Then immerse in 5 per cent. nitric acid for five minutes, and again wash for five minutes.

The print is then toned in the following sulphiding solution, which is the same for all three processes :—

Sodium sulphide . .	1 ounce.
Water	20 ounces.

The sodium sulphide should be pure and free from iron ; it is then practically odorless. The solution keeps indefinitely if well stoppered. It may be used several times over. Toning is almost instantaneous, but the print may be left in for a minute after it appears complete. It is then washed for ten minutes. If calcium hydrosulphide be used instead of sodium sulphide, a purple tint is imparted to the sepia.

The Chloride Process.

Bleach in—

Copper sulphate . . .	200 grains.
Sodium chloride (common salt)	200 „
Water	10 ounces.

Like the bromide solution, this preparation keeps indefinitely, and may be used repeatedly until exhausted. Wash for five minutes and immerse in 5 per cent. hydrochloric acid for three minutes, rinse in water, and again immerse in hydrochloric acid, then finally wash for ten minutes. Tone in the sulphide solution, and wash as usual.

My experiments in connection with the above two toning methods were very exhaustive before deciding to publish them in the technical press, but I am convinced of their chemical purity and of the permanent results given by them. I think the balance of merit is in favor of the chloride method, in that purity of the whites is rather more easily secured, and some control over the intensity of the final tone is obtained by exposing the bleached print to daylight, when partial reduction will occur, and

give rather more intensity to the tone; but I do not think such a pure sepia is produced.

The Iodide Process.

Bleach in—

Iodine	40 grains.
Potassium iodide . .	110 „
Water	10 ounces.

The iodine and iodide should be placed together in a measure and just moistened with water. Solution will then take place at once. If kept in the dark the solution preserves its strength for any reasonable time. It can be used several times over on the prints. Clear away the blue starch-iodine color by immersing in—

Sodium sulphite . .	80 grains.
Sulphuric acid (concentrated, pure)	24 minims.
Water	10 ounces.

A solution of potass metabisulphite (5 grains per ounce) may be used instead of this acid sulphite mixture. In either case fresh solution should be made up as soon as that in use fails to discharge the blue color rapidly.

If, after clearing, the conversion of the silver into silver iodide is found not to be complete, the print is washed and put back into the iodine solution.

Wash for fifteen minutes, and then tone with the sodium sulphide solution. Wash for one or two hours.

Later experiments with the iodine process show that the sodium sulphite bath may be omitted, as the sodium sulphide solution will discharge the blue coloration without affecting the result, but care must be taken to bleach thoroughly with the iodine.

The iodine method is due to Mr Blake Smith ; but, while the tone is similar to that obtained by the others, and consists of pure silver sulphide, there is an element of uncertainty in the fact that the silver iodide is soluble in sodium sulphite. Thus if the immersion be too prolonged it may seriously affect the scale of gradation. If 1 per cent. potassium bisulphite be used instead of sodium sulphite this danger will be obviated. There also seems to be some slight uncertainty as to the complete conversion into silver iodide.

One of the best of bleaching solutions is a combination of potassium bichromate and potassium

bromide acidified with a little hydrochloric acid. The image is converted into bromide of silver, and the stain removed with potassium metabisulphite.

Potassium bichromate . .	10 grains.
,, bromide . .	10 ,,
Water	4 ounces.
Hydrochloric acid . .	5 minims.

Bleaching is almost instantaneous.

Wash for three minutes, then immerse in a 1 per cent. solution of potassium metabisulphite till all stain is removed, and again wash for five minutes.

Some attention should be given to the texture of the paper of prints toned by the above processes. When thick, the time of washing between the various operations, and the application of the nitric and hydrochloric acid baths, should on no account be curtailed.

These processes are absolutely certain in their effects.

The Hypo and Alum, or "Boiling," Process.

For this process it is necessary to have a means of keeping the toning solution at a temperature of about 130° Fah., unless time is

no object. The toned image consists of silver sulphide, and as such possesses absolutely no advantage over the other processes in which the tone is produced by the formation of this same compound. True, the toning is completed in one operation, but this is of little moment when the time occupied exceeds that of the other processes by at least five times, even under the most favorable conditions. Toning may be carried out with a cold bath, but the time occupied is enormously increased. With this process we have the one exception to that universal and absolute law of the perfect washing of the print from hypo before toning. Prints may, if desired, be transferred from the fixing bath to one of 10 per cent. alum for five minutes, and then to the toning solution, which is composed as follows :—

Hyposulphite of soda (hypo)	10 ounces.
Powdered alum . .	2 ,,
Boiling water . . .	50 ,,

Dissolve the hypo in the hot water, and then add the powdered alum. A precipitation of sulphur will take place, giving a milky appearance to the solution. This must *not* be filtered off.

If the hot-bath method is used, the prints should be placed in it at a temperature of about 90° Fah., and heat applied to increase this to 130° Fah. They should be kept moving. Toning solutions may be used repeatedly, and the older a bath the quicker it tones, providing the active reagents have not all been used up, in which case it is only necessary to add a little fresh solution. When making up a solution for the first time, it is advisable to place in it some strips of old prints (bromides or unused P.O.P.), and allow to stand for at least twenty-four hours. The process is used commercially by some bromide paper manufacturers and trade enlargers, and they obtain the maximum speed of toning by constant use, the time varying from fifteen minutes to half an hour, according to the amount of silver deposit.

By the cold bath, prints tone in any time from two to twenty-four hours, and should be immersed face down if they are going to be left unwatched.

Considerable reduction takes place in this process, especially with freshly made solutions, and I have found it very difficult to estimate the proper allowance for this. It is obvious that the toning of very large prints, such as 40

ins. × 30 ins., is almost prohibitive for amateur workers.

Prints require washing for one hour after toning.

Prints in which the toned image consists of silver sulphide may be regarded as absolutely permanent.

Another method of producing sepia tones by means of a sulphide solution is to bleach or oxidise with *alkaline* ferricyanide of potassium; this will be found amongst other tones in which the same bleaching agent is used, in Chapter VII.

CHAPTER VI.

SEPIA TO RED CHALK—COPPER TONING.

This is undoubtedly one of the finest methods yet introduced, and Mr W. B. Ferguson, M.A., Q.C.,[1] to whom almost, if not entirely, all the credit is due, deserves the thanks of all bromide workers.

One of its greatest beauties lies in the extent of its range, within which a selection of at least ten distinct tones is possible. From the original black it runs up to a brilliant red chalk. Between these we get sepia, brown, purple-brown, purple, crimson-purple, red-purple, and shades of red up to red chalk of almost a vermilion tint. With the normal formula the time occupied for a fully toned print is from twenty to forty minutes, so that it is easily possible to stop the toning at any stage with certainty of obtaining the desired tone. Slight variation of

[1] *The Photographic Journal*, 1900, p. 133.

the composition of the toner produces little or no visible difference. There is no tendency to blisters, so that the print may be toned immediately after washing from fixation.

The formula is as follows :—

Copper sulphate, 10 per cent. solution	75 c.c.
Potassium citrate, 10 per cent.	1000 ,,
,, ferricyanide, 10 per cent.	66 ,,

This contains considerably more citrate than Ferguson's original formula, but no more than is necessary to prevent staining.

These separate stock solutions keep for any reasonable time : the ferricyanide should not be exposed to light. The mixture also will keep for a time before use, but it is not advisable to put it by from one batch of toning to the next.

Another for those who prefer to work in grains :—

Copper sulphate . . .	55 grains.
Potassium citrate . .	500 ,,
,, ferricyanide .	45 ,,
Water	10 ounces.

To prepare the first formula, the salts are dissolved separately in some of the water, say

10 grammes in 50 c.c., after which they are made up to 100 c.c. This constitutes a 10 per cent. stock solution, from which the toner is prepared in the proportions given. In mixing them, however, care must be taken to mix the potassium citrate and copper sulphate together first, and then add slowly, stirring or shaking the while, the potassium ferricyanide. If the last-named salt is not added in this way, an insoluble precipitate is produced and the toner thereby rendered useless. The preparation of the second formula is carried out in the same manner, using some of the total volume of water for the solution of the salts. The print is immersed in the toning solution and the dish rocked occasionally. Toning is stopped simply by washing, and this may be done at any stage to examine and decide upon the tint desired.

I commend this process as one of the finest ever introduced.

In the course of a series of experiments with this toner I have noted several further possibilities in regard to manipulating it for variation in tones, advantages accruing from some of which are not to be underestimated.

(1) The print, fully toned or at an intermediate stage, may be re-developed to the original black

with a developer used for bromide work, and may be re-toned. There is no stain produced in the high-light in the course of toning, and none with this procedure. There is no intensification produced by toning, and none upon re-development. A return to the original black cannot be produced with an ordinary alkaline solution, such as sodium sulphite, sodium hydrate, etc., as in the case of a platinum-toned print.

(2) If a fully-toned print be subjected to a solution of pure sodium sulphide, a very exquisite red sepia tone is produced, which is unaffected by a bromising solution of cupric bromide, or a strong alkali, and I have been unable to affect the tone in any way without first injuring the paper.

(3) A fully-toned print is but slightly affected upon immersion in cupric bromide and then hypo. It cannot, however, be re-developed after this treatment.

Permanency is claimed for an ordinarily toned copper print, but I think it should be placed in the same category as a platinum tone in this respect, since the same conditions seem to prevail upon treatment with cupric bromide and hypo, *i.e.* that the tint is produced by a combination of copper and silver.

Copper and Silver Sulphide.

As already mentioned, by a combination of the copper and sulphide processes a very pleasing red sepia is obtained. Tone to the final tint with Ferguson's copper formula, and then immerse in 5 per cent. nitric acid, wash, and apply the sodium sulphide solution already given.

CHAPTER VII.

GREEN TONES—VANADIUM AND IRON PROCESSES.

The perfect and simple production of a pure green tone has been a practical impossibility until recently. Several published formulæ for the same have for some years been in existence, but I have found them to be anything but satisfactory. The difficulty in getting rid of a bluish tinge without destroying the half-tones and deep shadows seems to be always present, and beyond that, the presence of a complete or partial, but permanent, stain in the emulsion.

Recently, however, the use of vanadium in the form of chloride has been suggested and the following formula published by Professor Namias :—

Bleach the print in 5 per cent. potassium ferricyanide [1] till white, and wash for half an

[1] If this is made alkaline with a few drops of strong ammonia, bleaching will take place in two minutes.—C. W. S.

hour; then immerse the print in a solution of the following composition :—

Ferric chloride . .	12 grammes.
Vanadium chloride .	10 ,,
Ammonium chloride .	25 ,,
Hydrochloric acid .	25 c.c.
Water . . .	2500 ,,

Dissolve the vanadium chloride in a little hot water to which the acid has been added, then the other salts, and then add the remainder of the water.

My experience of this method shows it to be only comparatively successful, and in this way :—There is first some difficulty in obtaining a completely bleached print under something like two hours, and, as I have found, at some risk of affecting the half-tones. Secondly, as in nearly all cases of initial bleaching, there is little or no control over the intensity of the image. Such factors go a long way towards interfering with the merits of a toning process; on the other hand, the process is fairly satisfactory under the best conditions.

In endeavoring to effect an improvement, my efforts were rather more successful than I at first anticipated, and keeping to vanadium as

the base, I eventually modified the process to a rather simpler formula and manipulation.

Immerse the print in the following without bleaching :—

Vanadium chloride . .	2 grains.
Ferric chloride . . .	1 grain.
Ferric oxalate . . .	1 „
Potassium ferricyanide .	2 grains.
Oxalic acid, sat. sol. . .	120 minims.
Water	4 ounces.

The solution should be light green and quite clear.

The vanadium chloride is best made into a stock solution of 50 grains in half an ounce of concentrated hydrochloric acid made hot by the addition of half an ounce of boiling water.

The ferric chloride, ferric oxalate, and potassium ferricyanide should be added together first, as, if the proportions are not strictly correct, a precipitate will occur which would render the solutions inactive ; thus if the precipitation did occur there would be no loss of the expensive vanadium salt.

The print is rocked in the toner till the highest lights have attained the pervading bright slate-blue tint ; it is then simply immersed

in water till the blue tint is discharged, when a pure green will result.

Most tones obtained with iron salts are liable to be destroyed if subjected to an alkaline solution; it is therefore advisable to watch the print from time to time, to remove it when the green tint is perfect. The time occupied in discharging the blue tint varies with the thickness of the paper, averaging from fifteen minutes to two hours. If the green color should be discharged, it may be returned by immersion in a weak solution of oxalic acid, about 1 per cent. strength. Prints should be mounted with a paste which is perfectly neutral or slightly acid.

In this process the shadow intensity is not raised, the green tint being imparted to the original black, a very desirable effect.

There are one or two modifications possible with regard to the color. Thus, if, after toning to the bright slate-blue, the print be immersed in a solution of zinc sulphate, a fine olive to sage-green tint may be obtained, the blue tint in the whites being almost instantaneously and permanently discharged.

Zinc sulphate . . .	5 grains.
Oxalic acid . . .	5 „
Water	1 ounce.

If the immersion be too prolonged the color will disappear, but may be returned after washing by the application of a 5 per cent. solution of oxalic acid.

Blue and Blue-Green.

A nearly pure blue tone may be easily obtained by immersing the print in the following :—

Potassium ferricyanide . .	2 grains.
Ammonio-citrate of iron .	1 grain.
Nitric acid	3 drops.
Water, ...	2 ounces.

Toning is fairly rapid, and should easily be complete in three to seven minutes. Wash for twenty minutes.

A blue-green tone is obtained by using hydrochloric acid instead of nitric. A still greener tint may be obtained by using hydrochloric acid, and when toning is complete immersing in the following till the blue is discharged :—

Ammonium hydrate (·880) .	10 minims.
Water	1 ounce.

Wash for two minutes and immerse in–

Potassium ferricyanide . .	1 grain.
Hydrochloric acid . .	5 minims.
Water	1 ounce.

Tone till complete, and wash for fifteen minutes.

The intensity of the shadows is well preserved in the above processes, the blue being imparted to the original black, but the shadows are slightly intensified after immersion in the ammonium hydrate.

A blue-green of a paler tint, in which the shadows are completely raised, is obtained as follows :—

Bleach in—

Potassium ferricyanide .	10 grains.
Ammonia (·880) . .	5 minims.
Water	1 ounce.

Wash for twenty minutes, and immerse in—

Ammonio-citrate of iron .	2 grains.
Hydrochloric acid . .	5 minims.
Water	1 ounce.

Continue toning till no further intensity can be obtained. Wash for twenty minutes.

Blue Tones with Alkaline Ferricyanide.

A series of very fine tones may be obtained by first converting the black-and-white image into silver ferrocyanide by oxidation with potassium ferricyanide.

A great objection to potassium ferricyanide as a bleaching agent was the time required to completely bleach the print, varying from three to twenty-four hours. I got over this difficulty by making the ferricyanide alkaline with ammonia, which has no prejudicial action for toning purposes. Potassium ferricyanide in an alkaline solution is a very powerful oxidising agent, bleaching an image in infinitely less time than a neutral solution. Thus, a 5 per cent. solution to which 1 dram of 10 per cent. ammonia has been added to every ounce will completely bleach a print in three minutes.

The washing of the bleached print must be very thorough, not less than twenty minutes in running water or half an hour in frequent changes.

For brown and sepia tones the washed print is immersed in a solution containing sulphuretted hydrogen, such as sodium sulphide, of which a 5 per cent. strength is about the best.

Potassium ferricyanide does not bleach the shadows as completely as iodine or cupric bromide; therefore tones of a rather better sepia tint may be obtained.

Wash the print as usual after toning for ten minutes.

For blue tones immerse the bleached print in—

Ferric chloride . . .	10 grains.
Hydrochloric acid, 10 per cent.	5 drops.
Water	1 ounce.

This will give a fine blue tone, in which there is a tinge of French grey.

A brilliant blue is obtained by immersing the print in—

Ferric chloride . . .	50 grains.
Hydrochloric acid, 10 per cent.	30 minims.
Water	1 ounce.

From this brilliant blue a beautiful violet-purple may be obtained by washing and immersing in a 1 per cent. solution of ammonia. The print must be carefully watched during this process, as if it is carried too far it will become grey; hence there is some doubt as to its permanency.

A really very fine tone of a sepia color, with

a tinge of green underlying, may be obtained by immersing the brilliant blue print, after washing for five minutes, in the sodium sulphide solution. This I have found to be very permanent, and the peculiar tone is given by no other process.

A solution of bichromate of potash made acid with hydrochloric acid may be used as a bleaching agent for bromide prints, but I have found no advantage in it over the other processes, and the washing required to eliminate the stain is rather prolonged.

Potassium Ferricyanide Toner— Blue Tones.

A very brilliant blue tone, and one that is quite permanent, may be obtained by the following. Add together—

Ferric chloride, 10 per cent. solution	1 ounce.
Potassium ferricyanide, 10 per cent. solution . . .	1 ,,

The well-known precipitate of Prussian blue is formed. Either solution may be added to the other till no more precipitate is formed. This precipitate is then dissolved by decanting

the top liquor and adding potassium oxalate, 10 per cent. solution, as much as required. Shake or stir after each addition till the precipitate is dissolved, when a deep green solution will result, this being a combination of potassium ferrocyanide and ferric oxalate. The print is immersed in this till the desired tone is obtained. The action may be somewhat rapid; if beyond control, dilute with water, which will not interfere with the tone, except the dilution be too great. When toned, the print should be washed and immersed for a few minutes in hydrochloric acid, 2 per cent. solution. Again wash and dry as usual.

The tone may be changed if desired to a blue-violet by subjecting it to a 1 per cent. solution of ammonia.

If care be exercised, there will be no stain with this toner.

CHAPTER VIII.

TONING WITH GOLD AND PLATINUM—SOME MINOR PROCESSES.

Purple Tones with Gold.

Bleach the print in the cupric bromide bath, clearing with 5 per cent. nitric acid, then wash for a few minutes and apply the following :—

Gold chloride . . .	2 grains.
Ammonium sulphocyanide .	7 ,,
Ammonia (5 per cent. solution)	1 dram.
Water	2 ounces.

Add the gold to the ammonium sulphocyanide, and make up to 2 ounces with water ; then add the ammonia slowly, stirring the while. This solution becomes quite colorless.

Toning takes some little while, but should be complete in fifteen to twenty minutes. The color varies from a purple to purple-black, but the stronger the ammonia the deeper will be

the tint. The image is composed of deposited gold.

The ammonium sulphocyanide prevents the precipitation of the gold as fulminate, which occurs on the addition of ammonia to the chloride; the difficulty I had in preventing this when experimenting for the process nearly caused me to abandon it. I do not think the sulphocyanide performs any other function.

The image is permanent, since aqua regia is the only reagent that will destroy it.

Warm Tones with Gold.

The following is extracted from *The Bromide Monthly*:—

The usual cold black tone of a bromide print, admirable as it is, is frequently wished otherwise by the photographer, who desires to retain the facility of bromide and yet obtain tones of the warmth readily given by printing-out papers. The nature of the silver deposit, however, in bromide prints does not admit of toning with gold in the manner familiar to the users of P.O.P. The gold and sulphocyanide bath can be used for the purpose of imparting a blue-black tone to the print, and for that purpose a solution made as follows answers well:—

Ammonium sulphocyanide .	20 grains.
Gold chloride . . .	1 grain.
Water	5 ounces.

The blue tone given by this solution is as much as one can do when applying the gold direct to the unaltered bromide print.

The methods most in use for modifying the tone of bromides are based on the replacement of the reduced silver by the colored ferrocyanide of some metal, such as uranium, whereby tones from deep brown to a vivid red can be obtained. Ferrocyanide of iron also (Prussian blue) gives blue tones, but the colors produced by such means as these are crude in almost every case, and, what is more, the paper is frequently stained in the whites. The metallic ferrocyanides, moreover, do not give such a degree of stability as does a thin deposit of gold.

With these facts in view, the writer has sought for a method of obtaining warm tones on bromides by means of gold. The experiments have not been pushed very far, and the results are not as excellent as could be wished; but the method promises to prove satisfactory, and no doubt other workers with some time to devote to the subject might pursue it.

The method, in outline, was to convert the

silver image into chloride of silver, and to expose to light, whereby the image again makes its appearance of a chemical composition analogous to that of the image produced on chloride papers. It was then toned with gold as are these latter papers.

As a bleaching solution the following is the best :—

Potassium bichromate . .	1 ounce.
Hydrochloric acid . .	5 drops.
Water	20 ounces.

It is left in this solution until the image has entirely disappeared, and is then washed until the yellow stain caused by the bichromate is completely removed from it. We have now an invisible image of silver chloride, the high-lights being formed by the gelatine only. By exposure to light the chloride of silver will darken and the image will reappear. But here note that the state of affairs is not exactly similar to those of printing-out paper : there is no silver nitrate or other soluble salt of silver to play the part of "sensitiser" and assist the darkening of the silver chloride.

We *could* introduce this sensitiser by floating the print on a solution of silver nitrate, but the

result, during the exposure to light, would be the formation of stains upon the prints. We therefore use sulphurous acid as a reducer, and the results are satisfactory. The bleached and washed print is placed in a dish of water, to which a little sulphurous acid is added, and exposed to full daylight—sunlight if possible.

The image soon makes its appearance, being now of an agreeable reddish-brown color. Indeed, this tone can be preserved by rinsing the print at this stage and drying it.

For the gold toning, however, the print, which should be of its full original vigor, is washed for a few minutes and toned in the following bath :—

Gold chloride . . .	1 grain.
Distilled water . . .	4 ounces.
Levigated chalk . . .	10 grains.

This bath should have been allowed to stand before use until completely colorless.

A second bath which may be used is :—

A.

Sodium acetate . . .	130 grains.
Distilled water . . .	10 ounces.

B.

Gold chloride . . .	15 grains.
Distilled water . . .	$3\frac{1}{4}$ ounces.

The tones obtained are not identical with those given by printing-out papers. That, of course, naturally follows from the different molecular state of the silver chloride in the two cases. The toned bromide, however, is of a much warmer color than the original image. The tones are permanent, as the high-lights of prints contain no silver salt capable of being reduced. The print, dried with no further treatment than a brief rinse, has a fine brown tone, which deepens on drying.

As it is probable that the reduction of the chloride has not been absolutely complete in the deepest shadows, and that a little chloride of silver may therefore remain in them, the prints can be passed for a few moments through a 10 per cent. solution of sodium hyposulphite. This final fixing is not really necessary for the proper permanence of the prints, in the writer's experience, and it considerably modifies their color. In it, they more or less completely lose their brown tone, and change towards black or violet.

Gold (Blue-Black).

With gold as the base, prints may be toned to a blue-black color with the following :—

A.

Ammonium sulphocyanide .	20 grains.
Water	1 ounce.

B.

Gold chloride . . .	2 grains.
Water	1 ounce.

When quite dissolved, add B gradually to A, shaking continuously.

Immerse the print till the desired tone is reached, then wash as usual. Prolonged immersion will produce a deep blue tone.

This formula is chiefly useful for prints which, by forcing in development or by over-exposure and development in a solution containing a heavy dose of bromide, are of a nasty greenish or brownish color.

Minor Processes with Gold and Platinum.

Black Tone with Platinum.

The washed print is immersed in the following :—

Potassium chloroplatinite .	1 part.
Hydrochloric acid . .	10 parts.
Distilled water . . .	1000 ,,

Allow to remain in for about twenty minutes, and then thoroughly wash and fix.

A pure black image is obtained, consisting of platinum.

Platinum Black.

A pure black image consisting of platinum is obtained as follows :—

Bleach the print in—

Mercury bichloride, saturated solution	1 ounce.
Hydrochloric acid . .	5 minims.

Wash for ten minutes, and re-develop with an ordinary developer.

Wash for ten minutes, and tone in—

Potassium chloroplatinite .	1 grain.
Oxalic acid . . .	10 grains.
Water	2 ounces.

Wash for fifteen minutes.

Platinum.

Platinum perchloride . .	1 part.
Distilled water . . .	2000 parts.
Hydrochloric acid (conc.) .	25 ,,
or	
Potassium chloroplatinite .	1 ,,
Distilled water . . .	1000 parts.
Hydrochloric acid . .	10 parts.

The print is placed in this till the desired tone is obtained.

As in this process the platinum is substituted for the silver, the print should be fixed and washed in the usual way; or if it be desired to entirely eliminate any remaining silver, immerse it in the following for about five minutes :—

Copper sulphate . .	200 grains.
Potassium bromide . .	200 ,,
Water	10 ounces.

Any silver remaining in the print will be converted into silver bromide, which may be dissolved out in the fixing bath; or if desired may be intensified before fixing by re-developing with any developer used for bromide work. Also before fixing, if it be exposed to daylight, it may be developed in shades varying in color

according to the duration of the exposure. A better rendering of this effect is obtained if the remaining silver after toning be converted into the chloride in the following solution :—

A.

Calcium chloride, cryst. .	10 parts.
Distilled water, . . .	50 ,,

B.

Copper sulphate . . .	15 parts.
Distilled water . . .	100 ,,

Mix the two solutions and filter, and wash the filter paper with 50 parts of water. Immerse the print for about five minutes, after which it should be washed for not more than one minute.

CHAPTER IX.

MISCELLANEOUS MINOR PROCESSES.

Bartolozzi Red Tones—Sodium Thioantimoniate (Schlippe's Salt).

The prints are first bleached in the following :—

Potassium bichromate . .	20 grains.
Hydrochloric acid . .	2 drams.
Water	10 ounces.

Wash till quite free from yellow stains, and then immerse in the following.

Sodium thioantimoniate .	15 grains.
Water	1 ounce.

Filter if necessary. Considerable intensification obtains with this toner.

Care should be taken to obtain the sodium thioantimoniate perfectly pure, otherwise toning will not be successful.

Blue, Green, Sepia, and Red Tones—Lead Ferricyanide Process.

Prints are first placed in the following :—

Lead nitrate . . .	$\frac{1}{2}$ ounce.
Potassium ferricyanide . .	$\frac{3}{4}$,,
Water	12 ounces.

The prints will bleach to a pale yellow.

Wash thoroughly. It will be seen that the bleaching action continues during washing, and as the extent of the bleaching has a definite effect on the subsequent tones, it is advisable to make a few trials on some valueless prints to see when to remove them from the above bath.

For blue tones the bleached print is treated with the following :—

Iron perchloride . .	300 grains.
Water	6 ounces.

Wash and dry as usual.

For green tones the bleached print is treated with :—

Neutral potassium chromate	220 grains.
Water	12 ounces.

Wash and apply the following :—

Iron perchloride . .	220 grains.
Water	12 ounces.

Wash and dry as usual.

For sepia and reddish tones the bleached print is treated in the following :—

Copper chloride . .	300 grains.
Water	6 ounces.

When desired tone is obtained wash and dry as usual.

Prints bleached with the lead salt are very liable to be stained if great care be not exercised in the manipulations.

Chocolate to Red Tones—Uranium Toning.

This toner has in past years been very popular, due, I am convinced, to the fact of the ease and rapidity with which toning may be effected. Personally, I cannot see what claims it has over others which give a similar tone. It is the least permanent of all metallic deposit toners, and less than many metallic salt toners. The fact that the tone washes away with excessive washing should be almost sufficient to condemn it, let alone the difficulty

of obtaining similarity of results. The sepia tone, which is its great claim, I have never yet seen obtained by it. I am not color-blind, and know the difference between a dirty red-brown and pure sepia.

For the benefit of those who may wish to use it, I give what I believe is the best formula :—

Uranium nitrate . .	20 grains.
Potassium ferricyanide .	20 „
Water	20 ounces.
Glacial acetic acid . .	1 ounce.

Dissolve the uranium and potassium ferricyanide separately in half of the water, then mix and add the acid. This bath will not keep more than thirty minutes. A considerable change of tone can be obtained by varying the proportions of the salts. If the uranium salt be in excess, the tones will tend to a brown sepia ; if the ferricyanide salt be in excess, the tones will incline to a red. The prints lose considerable tone if washing be prolonged ; it is therefore advisable to slightly overtone them and wash but slightly. After washing, flood them with the following :—

Ammonium sulphocyanide .	10 grains.
Water	1 ounce.

Allow to remain in this bath till the whites have cleared, and then wash for five minutes. Dry as usual.

Brown, Red, Green, and other Tones.

The following concise description of methods for obtaining various tones on bromide paper, by Mr B. C. Roloff, is extracted from *The Bromide Monthly*:—

The best results are obtained from images which have not been allowed to obtain too much vigor. After fixing and well washing, the prints should be bleached in either a bichloride of mercury and hydrochloric acid bath, as is usually done before intensification, or in the following bleaching bath:—

Nitrate of lead . . .	$\frac{1}{2}$ ounce.
Ferricyanide of potassium .	$\frac{3}{4}$,,
Distilled water . . .	12 ounces.

Filter. Wash well after bleaching.

A beautiful brown can be secured by immersing a bleached print in a strong ammonia bath; but to get the best results the prints should be fumed. To do this with the least trouble, take an old plate box and either soak the bottom with ammonia or put half an ounce in a

small dish, and set it on the bottom. Fasten the print (which may be first blotted) to the cover, and close the box. Fume for about four minutes, and wash well. An even brown tone, free from blotches and stains, is obtained by this method.

Different shades of brown can be secured by dropping the bleached print in hypo solutions of different strength. The browns secured in this way are very fine, with clear whites.[1]

Immersion in a solution of—

Potassium bichromate . .	1 part
Ammonia	1 ,,
Water	10 parts

produces a dark brown with a mercury-bleached print, and a reddish yellow with the lead-bleached print, the yellow being more pronounced when bichromate is added.

A bath of—

Potassium sulphocyanide .	1 part
Water	10 parts

tones brown and blue-black, according to the length of time a print is immersed.

[1] I have found the tones obtained by this method to be very impermanent.—C. W. S.

A solution of—

Sodium carbonate . . .	1 part
Water	10 parts

tones red-brown.

Sodium sulphite . . .	1 part
Water	10 parts

tones to a dark brown.

A bleached print immersed in a solution of nitrate of silver, 40 grains to the ounce, to every ounce of which from 10 to 20 drops of ammonia are added, gives a peculiar brown tone.

Immersion in—

Sulphate of copper . .	1 part
Water	10 parts

will produce a pleasing red.

A lead-bleached print immersed in—

Chloride of cobalt . . .	1 part
Water	5 parts

tones from green to grey, according to length of immersion. If the green print, toned as above directed, is immersed in—

Sulphate of copper . .	1 part
Water	10 parts

the tone slowly changes to a reddish grey.

Yellow tones are produced by a bath of—

Neutral chromate of potash	1 part.
Water	10 parts.

This color may be changed to different tones as follows :—

Brown, by treating with—

Permanganate of potash	1 part.
Water	10 parts.

Copper-red, by immersion in—

Cupric chloride	1 part.
Water	10 parts.

Red-brown, by treating the yellow image with :—

Nitrate of uranium	1 part.
Ammonium chloride	1 ,,
Water	10 parts.

Deep yellow, by treating the yellow image with—

Iodide of potassium	1 part.
Water	10 parts.

Green, by immersing the yellow image in—

Ferric chloride	1 part.
Water	10 parts.

To obtain a blue tone, the print, after being fixed and washed in the usual way, is placed direct (without previous bleaching) in a bath mixed in the following order :—

Ammonio-citrate of iron, saturated solution . . .	1 dram.
Potassium ferricyanide, saturated solution . . .	1 ,,
Hydrochloric acid . .	2 drams.
Water	5 ounces.

In this bath the black print turns rapidly to a dark blue, changing to a rich Prussian blue. After the desired tone is obtained the print should be well washed in running water to clear the whites. A still darker blue or blue-black may be obtained by using ten ounces of water in the foregoing bath instead of five.

A beautiful warm black tone is obtained by first bleaching in the bichloride of mercury, well washing, and immersing the print in a bath composed of—

Water	5 ounces
Ordinary combined toning and fixing bath . . .	½ ounce

and again well washing.

Pretty green tones may be had by adding about 20 grains of uranium nitrate to the blue-tone bath given above. In this case change the print from water to the bath until the desired tone is secured, as prolonged soaking will color the whites. Wash in several changes of water.

All these tones in an infinite variety of shades are easily produced on black-and-white bromide prints, but care must be taken to wash the prints well between the chemical baths, and to thoroughly wash in running water when the desired tone is secured.

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